REMARKS

This amendment is responsive to the Office Action of May 2, 2008. Reconsideration and allowance of the claims 1-7, 9, 10, and 12-19 are requested.

The Office Action

Claims 1-2 and 17 stand rejected under 35 U.S.C. § 112, second paragraph.

Claims 1-7 stand rejected under 35 U.S.C. § 102 as being anticipated by Zhu (US 7,009,396) in view of Watkins (US 6,492,814).

Claims 8-19 stand rejected under 35 U.S.C. § 103 as being unpatentable over Zhu in view of Watkins.

The References of Record

Zhu is concerned with imaging a continuously moving patient to generate a 3D image which is larger than the field of view of the magnetic resonance apparatus. In the detailed description before col. 7, line 59, Zhu describes an embodiment using an RF coil, such as a whole body coil, surface coil or head coil (col. 4, line 34) which is switched between transmit and receive modes (col. 4, line 5). In order to combine the data seamlessly, Zhu generates sub-images that are offset by one half the field of view. The odd k-space base data lines and the even k-space data lines are collected in alternate sub-images (col. 6, lines 41-67). It should be noted that in the context of standard, non-accelerated imaging, sub-image is used in the sense that each has only the even or odd k-space data lines.

After col. 7, line 60, Zhu adapts the previously discussed technique to parallel imaging such as SENSE (col. 8, line 40). In SENSE imaging, different RF receive coils may have different sensitivity weightings at different table locations (col. 8, lines 47-48). Zhu proposes two strategies to address the sensitivity weighting issues (col. 8, line 51). First, Zhu proposes to make the coil array elements 30 long enough to extend the full range of travel which reduces the B1 field variations and appears to eliminate the need to use different sensitivity weightings at different table locations (col. 8, lines 52-59). Second, Zhu proposes to take into account both the B1

field maps and the table locations and correct for the field of view changes algebraically (col. 8, lines 59-61).

Zhu does not explain where these B1 field maps come from or how they are generated. It appears that the B1 field maps may have been generated at a prior time and stored in a memory. Regardless when the B1 field maps were generated, there is no description of how they were generated and with what conditions. Errors in the field maps, such as attributable to table locations, are corrected algebraically or, alternatively, by designing the magnetic resonance imager with very long coil elements. There is no suggestion of generating the B1 field maps using parameters of an imaging sequence to follow to minimize the errors.

Watkins adds virtually nothing to Zhu. Zhu does not disclose how patient movement/location during continuous movement is measured (possibly by monitoring the physical movement of the patient support 134 or the commands sent to the drive therefor). Watkins tells us that the position can be monitored using a tracking coil 200. Thus, if one were to combine the fair teachings of Watkins and Zhu, one would monitor the movement of the patient through the examination region of Zhu using a tracking coil.

The Present Application

Unlike Zhu and Watkins which are particularly concerned with artifacts attributable to imaging a moving subject, the present application is merely concerned with generating better B1 field maps for any purpose. More specifically, the present application coordinates the sequences used to generate the B1 field maps with the sequences used to generate diagnostic images using the field maps.

By contrast, in Zhu, the B1 field map is just there, with no explanation how it came into being.

The Claims Distinguish Patentably Over the References of Record

Claim 1 calls for a method of improved coil sensitivity estimation for reducing artifacts in parallel imaging. A calibration sequence is performed as is a parallel imaging sequence. In a spin echo type sequence, the phase encode direction of both the calibration and parallel imaging sequences are matched. In Zhu, there is

no explanation of the origin of the B1 field map referenced at col. 8, line 60. There is no disclosure and no suggestion either that the B1 field map of Zhu should have been generated using a spin echo sequence or that it should have been generated using a sequence in which the phase encode directions of the calibration and parallel imaging sequences match.

In a gradient type sequence, the phase encode direction of both the calibration sequence and the parallel imaging sequence are again matched. By contrast, in Zhu, there is no explanation regarding how the B1 field map is generated or the direction of its phase encode direction, much less of any coordination in the phase encode directions of the calibration and parallel imaging sequences.

Watkins which goes only to patient movement measurement, does not cure these shortcomings of Zhu.

Claim 2 calls for the calibration sequence to be performed for each parallel imaging sequence. By contrast, col. 8, lines 59-61 suggest that the Zhu B1 field map is generated at some prior time, not necessarily for each imaging sequence and, if changes are needed, such changes should be done algebraically. Changing an earlier B1 field map algebraically teaches against performing the calibration sequence again for each parallel imaging sequence.

Claim 5 calls for not only the phase encode gradient but also the readout gradient to be in the same direction in both the calibration sequence and the parallel imaging sequence. Moreover, claim 5 calls for the readout gradient to have the same magnitude in both. In Zhu, there is no explanation regarding the readout gradients, much less their direction or magnitude of the gradients, that were used to generate the B1 field map.

Claim 7 calls for the open magnet to have the B1 field extending orthogonal to the long axis of the patient rather than the B1 field orientation found in bore type magnets such as used by Zhu or Watkins. Such a B0 field can cause phase errors at the edge of the field of view. Because neither Zhu nor Watkins has a B0 field with such an orientation or addresses the problem of phase errors at the edges of the field of view, it is submitted that neither Zhu nor Watkins teach or fairly suggest solving this problem.

Accordingly, it is submitted that **claim 1 and claims 2-7 and 17-19** dependent therefrom distinguish patentably and unobviously over the references of record.

Claim 9 calls for the sequence controller to perform controls such that the calibration sequence and the diagnostic imaging sequence are both spin echo type sequences. Zhu provides a list of known MR sequences (col. 8, line 67) and makes no suggestion of coordinating the calibration sequence and the diagnostic imaging sequence such that they are both a spin echo type sequence.

Moreover, **claim 9** calls for the phase encode gradient direction used during the calibration sequence to be the phase encode gradient direction which was retrieved from the diagnostic imaging memory. Zhu does not teach or fairly suggest coordinating the phase encode gradient directions of the calibration and diagnostic imaging sequences.

Claim 10 further calls for coordinating the read gradients. Again, Zhu does not disclose how the B1 field map is generated.

Claim 12 calls for the calibration sequence to be a spin echo sequence and for the diagnostic imaging sequence to be other than a spin echo sequence. Zhu does not disclose what type of sequence is used to generate the B1 field map.

Accordingly, it is submitted that **claims 9, 10, and 12** distinguish patentably and unobviously over the references of record.

Claim 13 calls for generating sensitivity maps from spin echoes with the phase encode direction selected for the parallel imaging sequence to follow. Zhu does not address and makes no suggestion that a B1 field map should be generated using spin echoes, much less that the phase encode direction selected for the calibration sequence should be the same as that which will be used in the parallel imaging sequence. It will be noted that in Zhu, the read or frequency encode direction is parallel to the axis of subject motion (col. 5, lines 43-44). Because this is not the normal orientation for a read gradient, it is submitted that using this unusual readout gradient directions suggests that the B1 gradient field map was generated with different phase encode and readout gradient directions than the diagnostic image.

Accordingly, it is submitted that **claim 13 and claims 14 and 15** dependent therefrom distinguish patentably and unobviously over the references of record.

35 U.S.C. § 112

Claims 1-7 have been amended to address the language issues raised by the Examiner. Moreover, the other claims have also been reviewed and revised, as appropriate, to mitigate any further 35 U.S.C. § 112 issues which the Examiner might raise.
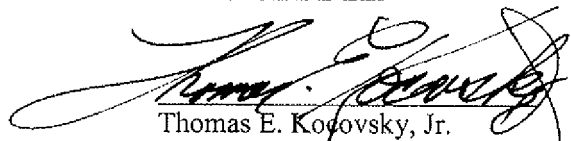
CONCLUSION

For the reasons set forth above, it is submitted that claims 1-7, 9, 10, and 12-19 distinguish patentably and unobviously over the references of record and meet the other statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, she is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

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